Presented by Dr.D.SHARP,
F.R.S. 20-xi-14.

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THE BROWN-TAIL MOTH AND HOW TO CONTROL IT.

BY

L. O. HOWARD,
ENTOMOLOGIST.

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LETTER OF TRANSMITTAL.

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ENTOMOLOGY,
Washington, D. C., August 30, 1906.

SIR: I have the honor to transmit a brief account of the brown-tail moth (*Euproctis chrysorrhœa*), with some consideration of methods of control, which I believe is suited for publication as a Farmers' Bulletin.

Very respectfully,

L. O. HOWARD,
Entomologist and Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE BROWN-TAIL MOTH AND HOW TO CONTROL IT.

INTRODUCTION.

The brown-tail moth (*Euproctis chrysorrhœa* L.) is a European moth of the family Liparidæ, accidentally introduced into New England about fifteen years ago, and which has rapidly spread until at the present time it covers a large extent of territory and threatens still further rapid spread. It is an injurious enemy of orchard, forest, and shade trees and of ornamental shrubbery. It is being strenuously fought in Massachusetts under a large appropriation devoted to its suppression and to that of the gipsy moth (*Porthetria dispar* L.). The other New England States in which it occurs are also beginning or about to begin the enforcement of remedial measures, and much intelligent work has been done by communities in the State of Maine during the past year. During the last session of Congress a sum of money was appropriated to be expended under the Bureau of Entomology in preventing the further spread of the gipsy and brown-tail moths, and it is in furtherance of this end that the present bulletin is published. Actual antispreading work can be done to advantage against the gipsy moth, since the female of this insect does not fly and the species is spread only in the larval or caterpillar stage, when it spins down from roadside trees and alighting upon some vehicle or person is thus carried for long distances. With the brown-tail moth, however, the case is entirely different. As will be shown, the female flies readily and is carried during its period of flight by the prevalent winds for very long distances. It is therefore much more difficult to prevent the spread of this insect than of the other, and in fact the only effective measures are those of actual work in the extermination of the insect wherever it occurs. To attempt such work as a Government measure and with the funds appropriated by Congress would be futile. It is safe to say that to effectively check the further spread of the brown-tail moth would require its complete extermination; and to bring this about millions of dollars would have to be spent. Plainly the thing to do, therefore, with regard to the brown-tail moth, is to secure the active and intelligent cooperation of all property holders thruout the infested district. This must be done primarily by a campaign of

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education. Then communities must take the matter up thru town-improvement societies and organizations of other character, and, best of all, sound State laws comparable to the one now operating in the State of Massachusetts must be enacted and enforced in the other States. This bulletin is prepared to aid in the first step—education. Other bulletins have been issued by the Superintendent for Suppressing the Gipsy and Brown-Tail Moths in Massachusetts, by the Commissioner for the Suppression of the Gipsy and Brown-Tail Moths in Rhode Island, and by the State entomologists of New Hampshire, Maine, and Connecticut. All of these bulletins[a] have been published within the last eight months.

The subject has also been covered by the New York State entomologist, Dr. E. P. Felt, of Albany, N. Y., and by the New Jersey State entomologist, Dr. John B. Smith, Rutgers College, New Brunswick, N. J. These last two publications are in annual reports, together with a consideration of other insects, and are not specific bulletins, as in the case of the others.

THE BROWN-TAIL MOTH IN EUROPE.

The brown-tail moth has a wide Old-World distribution. It has for many years been a well-known member of the so-called Palearctic fauna. It extends from England east to the Himalayas, and has been found as far north as Sweden and as far south as Algeria. It is well known as an orchard pest thruout the greater part of this range, and has occasionally appeared in such numbers as to attract general attention. For nearly a hundred years laws have been operative in parts of Europe requiring property owners to clear their trees of the winter nests. The life history of the insect has been well known in Europe for about two hundred years, has been the subject of many publications, and is referred to in most of the general works.

INTRODUCTION INTO AMERICA AND SUBSEQUENT SPREAD.

The attention of entomologists was first drawn to the occurrence of this species in the United States in the spring of 1897, when certain residents of Somerville and Cambridge, Mass., found a strange caterpillar feeding on the unfolded leaves of their pear trees. The attention of the State of Massachusetts gipsy moth committee was called

[a] Persons desiring to consult these publications may apply to the following officials:
Mr. A. H. Kirkland, 6 Beacon street, Boston, Mass.
Prof. A. E. Stene, Kingston, R. I.
Prof. E. Dwight Sanderson, New Hampshire College, Durham, N. H.
Prof. E. F. Hitchings, Augusta, Me.
Miss Edith M. Patch, Agricultural Experiment Station, Orono, Me.
Prof. W. E. Britton, Agricultural Experiment Station, New Haven, Conn.

to the matter during that year, and the identity of the form with the well-known European species was determined by Messrs. Fernald and Kirkland.

An investigation was at once made as to the probable time and method of introduction. The fact was established that the moth had been in Somerville for several years previous to 1897, gradually becoming acclimated and slowly spreading outward into noninfested territory. The balance of evidence seems to indicate that the species was probably introduced from Holland or France upon rose bushes imported by a florist in Somerville about 1890.

Down to 1897 the spread of the insect had evidently been slow, but the danger was imminent, and during the spring of that year the writer, together with a representative body of Massachusetts agriculturists and officials, appeared before the governor of the State and urged the passage of an appropriation bill providing means for its extermination. Six thousand dollars was appropriated by the legislature to be expended by the gipsy-moth committee of the State board of agriculture. Careful examination showed that at that time fifteen towns were infested, the insect being found upon 2,226 estates. As much as could be done was done under the appropriation, and a certain amount of work was carried on during the following two years. Then all State appropriations were stopt, both against this insect and the gipsy moth, and for five years the insect spread unchecked except by the work done by individual property holders and town-improvement societies.

In 1899, when the work stopt, an area of approximately 928 square miles was infested, extending from the ocean along the New Hampshire line to the western border of the town of Methuen, thence practically directly southward to Newton, and thence the limiting border extended gradually in a southeasterly line to Cohasset, including the entire suburbs of Boston. In 1903 a report was published by the State of Massachusetts, under the authorship of C. H. Fernald and A. H. Kirkland, giving a full account of the insect and indicating that between the autumn of 1899 and that of 1902 nearly 600 square miles of territory had been added to the American range of the species, which had spread out to Kittery, Me., and had included a large portion of southeastern New Hampshire. One occurrence at St. John, New Brunswick, was reported also.

By the close of 1905 the two lower tiers of counties in New Hampshire had become generally infested, and specimens had been sent in to the State entomologist of New Hampshire from the White Mountain region. Notable flights of the moths had been observed at Nashua, Concord, and Portsmouth. In Maine the insect had been found scattered along the coast at various places—Portland, Rockland, and

Augusta were generally infested; the insect had appeared in considerable numbers on the island of Mount Desert; and had been reported at Eastport. A single finding also had been reported at Providence, R. I., but the insect had not been found in the State of Connecticut. In Massachusetts there had been a wide spread to the southward and a slower spread to the westward, the species having been found as far east as Amherst. Full reports have not been made of the additional spread during 1906, nor will it be possible accurately to make such reports until the leaves fall in the autumn and the winter nests are readily to be seen.

DESCRIPTION OF THE INSECT.

The eggs.—The eggs of the brown-tail moth are small and globular, and are laid in masses on the underside of leaves in the latter part of

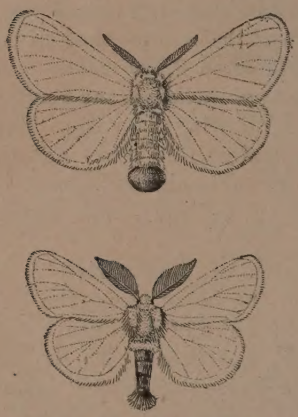

FIG. 1.—The brown-tail moth (*Euproctis chrysorrhœa*): Female moth above, male moth below, larva or caterpillar at right. Slightly enlarged (original).

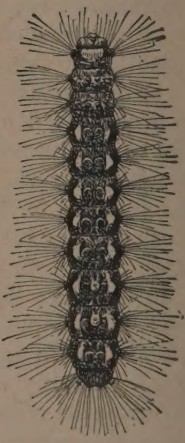

FIG. 2.—Caterpillar of the brown-tail moth. Enlarged (from Fernald and Kirkland).

July. The egg masses are brown in color and are covered with hair, each mass containing about 300 eggs. They are much smaller than the egg-masses of the gipsy moth, with which they are most likely to be confused, and average about two-thirds of an inch in length by about one-fourth of an inch in width. They are thus elongate in form, and are convex.

The larva or caterpillar.—The full-grown larva (fig. 1 at right; fig. 2) is about 2 inches long, reddish brown in color, with a broken white stripe on each side and two red dots on the back near the hind end. It carries also patches of orange and is covered with tubercles bearing long barbed hairs. The tubercles along the back and sides are covered

with short brown hairs in addition to the longer ones, which give the tubercles when magnified an appearance like velvet. The head of the larva is pale brown with darker mottlings.

The young larvæ are of a blackish color covered with reddish brown hairs. The head is jet black. Close examination will show projecting from the back of the fourth and fifth abdominal segments a large tuft of reddish brown hairs, and on the middle line of the ninth and tenth segments is an orange or reddish tubercle which may be withdrawn into the body. After the second spring molt the larva is about three-eighths of an inch long, the yellow markings on the body are more apparent, and the brown tufts on the back less prominent, while the band of white dashes along the sides, characteristic of the full-grown larva, is noticeable.

FIG. 3.—Brown-tail moths on electric-light pole, Malden, Mass., July 12, 1905. (From Kirkland.)

The pupa.—The full-grown larva spins a cocoon of grayish silk, which is very loose in its construction and is so far from being compact that the pupa may be readily seen thru it. The pupa itself is about five-eighths of an inch long, dark brown in color, with a conical spine at the end of the abdomen bearing a cluster of minute hooks at the tip. Smooth, yellowish brown hairs are found scattered over the abdomen and the top of the thorax.

The cocoons are apparently spun by preference among the leaves at the tips of branches, and often a dozen or more larvæ will spin a common web within which each individual forms its own cocoon and transforms to pupa. The cocoons are also found under fences and beneath the edges of clapboards. Mr. Kirkland has seen a mass of cocoons nearly 2 feet across in the cornice of a house in Somerville.

The adult or moth.—The moths (fig. 1, at left) are pure white, the end of the abdomen being brownish, and both sexes bear at the tip of the abdomen, more conspicuously with the female, a tuft of brown hairs, almost globular in form, from which comes the name brown-tail moth. It is the only moth occurring in America to which this description applies, and is therefore unmistakable. The female expands about 1½ inches, and the male is smaller.

SEASONAL HISTORY.

The moths fly in New England from the 1st to the 20th of July, the time varying with the condition of the season. In 1898 the height of the flying season is said by Fernald and Kirkland to have been July 16, in 1899 July 8, and in 1902 July 14. It is a night-flying insect, and only a few are ever seen on the wing in the daytime. Soon after sunset a few begin to fly, the number increasing as it grows dark, and from

FIG. 4.—Winter web of the brown-tail moth. (After Kirkland.)

10 o'clock to midnight they swarm to the greatest extent. They are strong flyers, and are attracted to light (see fig. 3). So great have been their numbers in the infested region that the sides of red brick buildings near electric lights have appeared perfectly white. It is at this time that the great spread of the species occurs, and the reason that the direction of the spread has been greatest toward the northeast has been the fact that the prevalent night winds at that time of the year seem to have been from the southwest. Aside from actual flight, the

species has spread by being carried in the moth condition on railway trains and on vessels. Captains of vessels have reported that the moths have alighted upon their ships in great numbers in the vicinity of Boston along toward midnight on several occasions, and the introduction of the species at more than one seaport in Maine has been by means of vessels coming from the infested district rather than by direct flight. Of course the brown-tail moth is carried in the caterpillar stage just as is the gipsy moth, upon vehicles of different kinds passing thru the infested region and upon the persons of pedestrians as well. In late May, 1906, the writer, in company with three other persons, walked thru the woods in a region not far from Boston, and altho the most careful efforts were made by each of us to pick the caterpillars from the clothes of the others, an hour or two afterwards and many miles away by automobile still others were found under the upturned trousers and lapels of coats and in other hidden places about garments.

Fig. 5.—Web of the brown-tail moth. (After Kirkland.)

The eggs are laid by the moths soon after the flight begins, say in the latter part of July. They hatch during August and the young larvæ feed in clusters on the upper surface of leaves, skeletonizing them and causing the foliage to turn brown as if blighted. At first they feed upon the leaf which bears the egg mass, but soon wander to others, returning at night to the original leaf. When first hatched they are about one-twelfth of an inch long, and in five to six days shed their skin, increasing in length to one-fifth of an inch.

Later the second molt occurs, altho this sometimes does not take place until autumn within the winter web. Along in September they begin to spin their winter webs by drawing together a number of leaves with silk, and in each of these nests a large number of caterpillars stow themselves away for the winter. These webs or nests, composed of leaves and silk, will average from 5 to 6 inches in length, and each will contain 200 or more caterpillars. The caterpillars feed until cold weather, and then all enter the web and close the exit holes. They are then about one-fourth grown.

These winter webs (figs. 4–7) of the brown-tail moth are very characteristic, and there are practically no other insect structures common upon trees which may be mistaken for them. There are certain old webs of native species which might possibly, by the untrained eye, be considered to be those of the brown-tail moth, but these are empty

FIG. 6.—Winter webs of the brown-tail moth, attached to fruit. (After Kirkland.)

in the winter time. Any web of this character and general size found during the winter which contains young caterpillars in any number is the web of the brown-tail moth.

The following spring, as soon as the buds begin to appear upon fruit trees, these young, one-fourth-grown caterpillars issue from the overwintering nests and attack first the buds and blossoms and later the foliage. Apparently half starved by their long hibernation, they

come out with voracious appetites, and the amount of damage done by them at this time is extraordinary. Old trees may lose all their buds, or, if the leaf buds and blossom buds burst, the foliage itself may

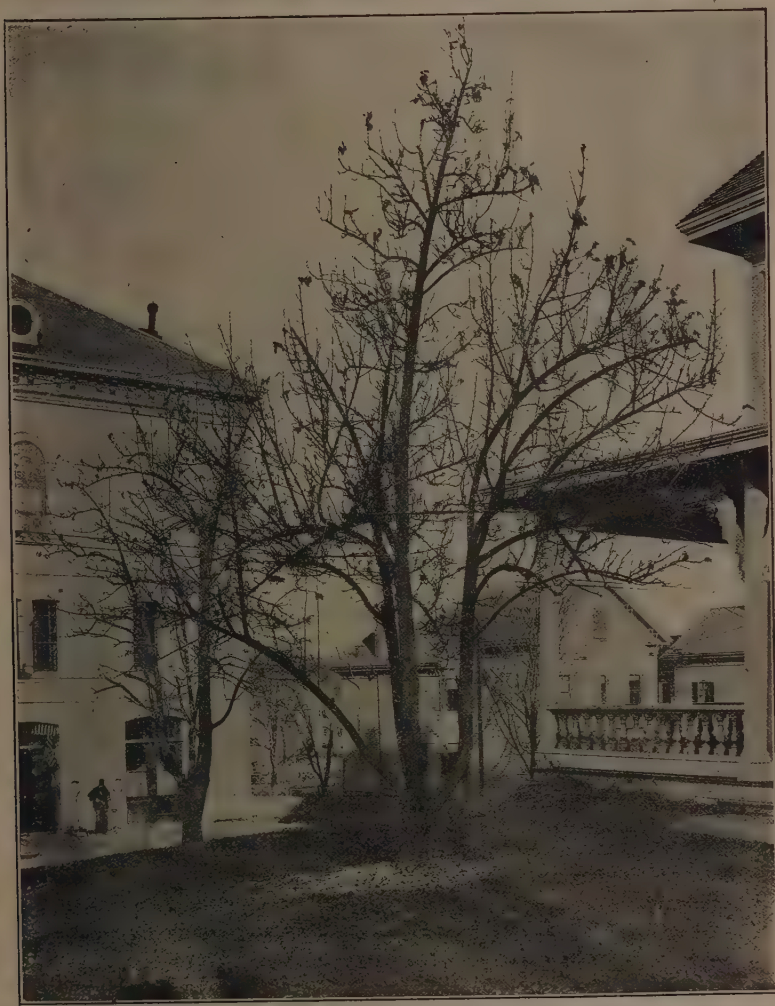

FIG. 7.—Winter webs of the brown-tail moth on pear tree, Melrose, Mass., December, 1905. (After Kirkland.)

be entirely destroyed at a later date. The growth of the larva is rapid, and it reaches full size and begins to spin its cocoon during the last half of June, transforming to pupa and remaining in this condition for approximately 20 days.

DAMAGE TO PLANTS.

As just indicated, the damage to trees and shrubs may be very severe. The list of food plants is very extensive. While there seemed at first to be a preference for pear (figs. 7, 8) and apple, the larvæ were found to feed also upon the stone fruits, as well as upon the elm, maple, and several species of oak. Of late years there has been a very extensive infestation of scrub oak and of the larger trees of the genus Quercus. In fact the caterpillars feed generally upon all deciduous trees, on many shrubs, and even upon herbage. A list of over 80 different food plants was published by Fernald and Kirkland in

FIG. 8.—Pear trees stript by the brown-tail moth, Winchester, Mass., June 9, 1905. (After Kirkland.)

1903. Thousands of fruit trees in the vicinity of Boston have been killed by this insect. Injury to woodlands and forests has not been as severe as that accomplished by the gipsy moth, and coniferous trees do not seem to be attacked, but the damage to oak, maple, and elm in the wooded region has been sufficient to cause the forests to appear brown in June in places, and complete defoliation for a series of three or four years has brought about the death of many trees. Even where the tree survives, its growth has been checked, and there is a timber loss.

BROWN-TAIL RASH.

The term "brown-tail rash" is well understood in eastern New England at the present time, although a few years ago it was practically unknown. The hairs of the brown-tail caterpillar are finely barbed and brittle (see fig. 9), and where the caterpillar comes in contact with the human skin these hairs enter the skin pores, break off, and cause a

FIG. 9.—Hairs of the caterpillar of the brown-tail moth, highly magnified. (Adapted from Kirkland.)

severe irritation. Indeed, it is not necessary for the caterpillar itself to come in contact with the skin; at certain times of the year it seems as though the hairs were actually floating about in the air. At the time of the caterpillar's change of skin, and particularly at the time of the spinning of the cocoon and the final change, certain of these hairs

appear to become loosened in such a way that they are carried by the wind. A few people have been made seriously ill by this so-called rash, and it is the cause of great annoyance. Extreme cases were noted during the past summer in the parasite laboratory at North Saugus. Two of the assistants who had charge of the American end of the introduction of the European parasites of the gipsy moth and brown-tail moth and were obliged to handle large numbers of the wintering nests brought over from Europe were poisoned to such an extent that their hands and arms were swollen to great size, their eyes were swollen nearly shut, and the irritation of the hairs in the throat and nasal passages was such as to cause alarming symptoms. Beginning with April, one of the assistants has had an almost constant cough from this cause, lasting to the date of the present writing (August 30). Persons engaged in removing the nests from trees in the winter time and in carrying them away to be burned also suffer from brown-tail rash, altho the trouble is not so great in the winter time as in the summer time, since during warm weather the pores of the skin are more open and more receptive to the hairs. A large part of the popular feeling in New England that the brown-tail moth must be exterminated is due quite as much to the prevalence and annoyance of this rash as to the loss of vegetation from the work of the caterpillars.

For a time the free use of vaseline was recommended for the so-called brown-tail rash, but of late cooling mixtures have been used in preference, and an excellent prescription which has been tried repeatedly with good effect is the following:

Menthol	grains	10
Zinc oxidi	drams	2
Aq. calcis	ounces	8
Acid carbolici	drops	15

This mixture is for external use.

The hairs which produce the worst effect are the short brown ones from the tubercles on the back and sides of the abdomen. They are illustrated in fig. 9. This nettling or urticating effect is not peculiar to the hairs of the brown-tail moth. A number of our native species carry similar hairs. The difficulty is apparently purely a mechanical one, and there is no accompanying specific poison.

NATURAL ENEMIES AND PARASITES.

Observations extending over a number of years show that birds are important in checking the spread of the brown-tail moth. The caterpillars, like other hairy species, are not so much eaten by birds, except by certain ones, such as the yellow-billed and black-billed cuckoos and the Baltimore oriole. The yellow-throated vireo and the bluejay also

feed upon them. When the moths emerge in number, however, they are preyed upon by a great many birds, and even the English sparrow destroys large numbers of them. July 16, 1897, Mr. Kirkland observed whole flocks of English sparrows following along the lines of fences carefully searching for the moths, which when found were greedily devoured. Of course many of these moths will have laid their eggs before they are destroyed, yet the work as a whole counts. Bats and toads also eat the moths as they fly about electric lights, the latter devouring them when they fall to the ground.

Certain of our native parasites which destroy allied insects like the fall webworm and the tussock moth also breed in the brown-tail moth, but the percentage of parasitism is very small.

An effort is being made to introduce the European parasites of both the brown-tail moth and the gipsy moth, and during the past year many thousands of such parasites have been introduced and liberated in the vicinity of Boston. They are first cared for in a laboratory at North Saugus; many of them are afterwards studied under outdoor tents, while still others have been liberated in the open in badly infested woodlands. The results down to the present time are encouraging, but it may be a matter of some years before appreciable results are obtained, and there is a possibility, also, that these European parasites will not multiply to the same extent as in Europe. Therefore active mechanical measures must still be continued, and perhaps for years to come, in the actual destruction of the injurious insect.

REMEDIES.

The most obvious means of controlling the brown-tail moth, and the easiest one, is the collection and destruction of the winter nests after the leaves have fallen. These webs, elsewhere described, are conspicuous from October to April. Many of them are within reach, and as each contains 200 caterpillars or more, each one capable of destroying a number of buds in the spring, the value of this work is at once evident. The webs should be removed before the first part of April. In Massachusetts, on the larger trees, are used long ladders and climbing irons, and some men make a business of destroying these nests upon private estates. The twigs carrying the nests are clipped off with one of the ordinary tree pruners (fig. 10) and the collected nests are burned.

After the leaves come out in the spring the nests remaining on the trees will be empty, and it is no longer worth while to make an effort to collect them. Practically the only remedy after this date is spraying with an arsenical mixture. When they are young the larvæ may be effectively destroyed by spraying with arsenate of lead. They may

also be destroyed by a Paris-green spray, in the proportion of 1 pound to 100 or even 150 gallons of water. A stronger mixture will burn the foliage. Arsenate of lead, however, may be applied much stronger, and this substance should be used when the caterpillars are larger. Mr. Sanderson, as the result of an experiment in New Hampshire, recommends 5 pounds of arsenate of lead to a barrel of water when the caterpillars are large.

FIG. 10.—Pruning shears suitable for removing the winter webs of the brown-tail moth. (From Fernald and Kirkland.)

Organized efforts have been made in many villages and towns, under the auspices of local associations, to secure the collection and destruction of the nests in the winter. In some cases the services of school children and others have been enlisted by the payment of a small bounty, and very many thousands of nests have been collected and destroyed in this way. Massachusetts is now working under a good State law, a summary of which is published below. Other States already infested or liable to infestation in the near future should pass similar laws.

THE MASSACHUSETTS LAW.

The following is a summary of the essential features of the Massachusetts law to provide for suppressing the gipsy and brown-tail moths:

The moths are public nuisances.—The gipsy and brown-tail moths are declared public nuisances and their suppression is required.

The superintendent of suppression.—A superintendent appointed by the governor with power, subject to the governor's approval, of appointing agents and assistants has entire general charge of the work of suppressing the moths.

Duties of cities, towns, and individuals.—Cities and towns (under the advice and general direction of the superintendent, and by such agent as they may designate or appoint) are required, under penalty for neglect, to destroy the eggs, pupæ, and nests of the gipsy and the brown-tail moths within their limits, *excepting* that such work is not to be done by cities and towns on property controlled by the Commonwealth, nor is it to be done upon private property, excepting where the owners of the same fail to destroy the eggs, pupæ, and nests of the moths, in accordance with the terms of the official notice to private owners noted in the section here following:

Notice to private owners.—The mayor of every city and the selectmen of every town shall, at suitable times, notify every owner of land

located therein which is infested with the moths, requiring him to destroy the eggs, pupæ, and nests of the moths within a specified time.

When the mayor or selectmen decide that the cost of such destruction (on lands contiguous and under one ownership) will exceed one-half of 1 per cent of the assessed valuation of the lands, then they may designate in the notice a part only of such lands on which the destruction shall take place.

Failure of private owners to destroy moths.—If the owner does not, as required by the terms of the aforesaid notice, destroy the eggs, pupæ, and nests of the moths, then the city or town, subject to the approval of the State superintendent, shall destroy them, and shall assess upon such aforesaid lands the actual cost of so doing, to an amount, however, not exceeding one-half of 1 per cent of the assessed valuation of the land.

This amount, so assessed, shall be collected in the form of taxes, and constitutes a lien upon such lands.

Redress by abatement and appeal.—The assessors may abate the moth assessment in the case of any private landowner decided by them to be unable to pay it because of age, infirmity, or poverty.

Appeal to the county superior court, with special provision for prompt hearing, is provided by the statute for any person aggrieved by assessment on account of this work; provided a complaint is entered within 30 days of notice of such assessment.

Appropriation by the Commonwealth.—To meet the expenses incurred under its moth-suppression law the Commonwealth has appropriated $300,000. Of this sum $75,000 may be expended during 1905, $150,000 (and any unexpended balance) during 1906, and $75,000 (and any unexpended balance) during 1907, up to May 1, 1907, inclusive.

For the purpose of experimenting with natural enemies for destroying the moths, $10,000 is additionally appropriated for each of the years 1905, 1906, and 1907.

Reimbursements to cities and towns.—(1) Cities and towns with valuation of real and personal estate of $12,500,000 or more, having spent $5,000 in any one calendar year, shall be reimbursed annually 50 per cent (one-half) of all further expenditure in combating this pest.

(2) Cities and towns with valuation less than $12,500,000 and more than $6,000,000, having spent an amount equal to one-twenty-fifth of 1 per cent of such valuation in one year, shall be reimbursed annually 80 per cent (four-fifths) of all further expenditure.

(3) Towns with valuation less than $6,000,000, having spent an amount equal to one-twenty-fifth of 1 per cent of such valuation in one year, shall be reimbursed once in 60 days for all further expenditure.

Limits to required expenditure by cities and towns.—No city or town with an assessed real and personal valuation of *more* than $6,000,000 shall be required to expend in the suppression of the moths during any one full year more than one-fifteenth of 1 per cent of such valuation. No town with an assessed real and personal valuation of *less* than $6,000,000 shall be required to thus expend during any one full year more than one-twenty-fifth of 1 per cent of such valuation.

Valuations of 1904 taken as basis.—Wherever valuations of real and personal property are referred to in the law for the suppression of the gipsy and brown-tail moth the valuations of 1904 are meant.

Wilful resistance or obstruction.—Wilful resistance to or obstruction of any agent of the Commonwealth or of any city or town, while lawfully engaged in the execution of the purposes of the moth-suppression law, is forbidden under penalty.

Copies will be sent to any address on application to any Senator, Representative, or Delegate in Congress, or to the Secretary of Agriculture, Washington, D. C.

No. 22. The Feeding of Farm Animals. No. 24. Hog Cholera and Swine Plague. No. 25. Peanuts: Culture and Uses. No. 27. Flax for Seed and Fiber. No. 28. Weeds: And How to Kill Them. No. 29. Souring and Other Changes in Milk. No. 30. Grape Diseases on the Pacific Coast. No. 32. Silos and Silage. No. 33. Peach Growing for Market. No. 34. Meats: Composition and Cooking. No. 35. Potato Culture. No. 36. Cotton Seed and Its Products. No. 37. Kafir Corn: Culture and Uses. No. 39. Onion Culture. No. 41. Fowls: Care and Feeding. No. 42. Facts About Milk. No. 43. Sewage Disposal on the Farm. No. 44. Commercial Fertilizers. No. 46. Irrigation in Humid Climates. No. 47. Insects Affecting the Cotton Plant. No. 48. The Manuring of Cotton. No. 49. Sheep Feeding. No. 51. Standard Varieties of Chickens. No. 52. The Sugar Beet. No. 54. Some Common Birds. No. 55. The Dairy Herd. No. 56. Experiment Station Work—I. No. 58. The Soy Bean as a Forage Crop. No. 59. Bee Keeping. No. 60. 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